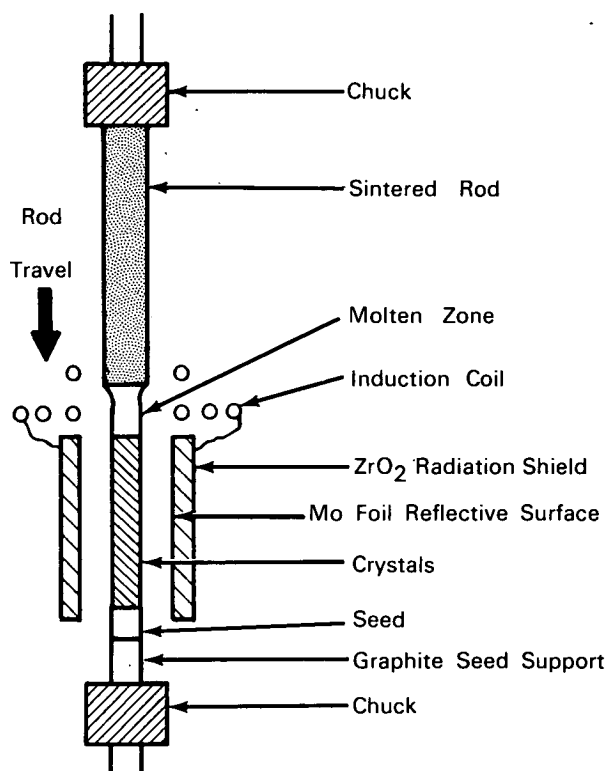


NASA TECH BRIEF



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Growth of Phase-pure, Crack-Free Single Crystals and Large-Grained Polycrystals of Molybdenum Disilicide



Schematic of zone melting pass showing positions of coil, zone feed bar, crystal and radiation shield

The problem:

Prepare improved crystalline molybdenum disilicide. Measurement and evaluation of the mechanical properties of this compound have been hampered by unavailability of high purity crystals. The "single" crystals previously available from arc-melting are

contaminated with Mo_5Si_3 and exhibit 20° angle grain boundaries.

The solution:

Zone-melt sintered compacts to prepare crystalline bars of molybdenum disilicide, single phase and free from macrocracks. The drawing shows a schematic of the zone melting apparatus used.

How it's done:

Mix 200 mesh molybdenum disilicide powder of 99.5% purity with an excess of 4% by weight semiconductor-grade silicon to compensate for evaporative losses during synthesis. Then load the powder mixture into a boron nitride boat, which is put into a furnace and fired at 1300°C for 3 hours in a flowing 95% argon-5% hydrogen atmosphere. The resulting sintered compact, about 7 in. in length by 1/2 in. in diameter, is zone melted in this atmosphere by passing an induction coil along its length. The two-turn induction coil couples directly to the MoSi_2 sample to produce melting.

This coil travels at about 1 in. per hour in making single crystals and at about 10 in. per hour in making polycrystals. Inserted in a ceramic tube is a molybdenum radiation shield, which travels behind the coil and allows the crystal to cool more slowly. The best quality single crystals are produced by seeding with an oriented single crystal seed free from macrocracks. Nucleation is rapidly established in the preferred growth direction, which is approximately 5° from the $[001]$ crystal axis.

(continued overleaf)

Notes:

1. The availability of high purity molybdenum disilicide as single crystals or polycrystals free from macrocracks allows the potential of the material to be explored for applications that take advantage of its excellent oxidation resistance, high strength, and metallic conductivity.
2. The following documentation may be obtained from:

Clearinghouse for Federal Scientific
and Technical Information
Springfield, Virginia 22151
Single document price \$3.00
(or microfiche \$0.65)

Reference:

NASA-CR-98504 (N69-70396), The Pest
Phenomenon in Intermetallics

Patent status:

No patent action is contemplated by NASA.

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